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# PATENT SPECIFICATION

NO DRAWINGS

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## COMPLETE SPECIFICATION

### Semi-Conductor Devices

We, INSTITUTE FYSIKI I MATEMATIKI, a Soviet Corporation, of Ulitsa Lempjuvju, 7, Vilnius, Union of Soviet Socialist Republics Union of Soviet Socialist Republics, do hereby declare the invention, for which we pray, that a patent may be granted to us, and the method by which it is to be performed, to be particularly described, in and by the following statement:—

10 This invention relates to computers and automation and constitutes an improvement in or modification of the method of preparing a film memory cell described and claimed in our co-pending application No. 15 24178 of 1963 (Serial No. 1093122).

As a modification of the method of preparing the film memory cell a thin layer of selenium, 2 to 3 microns thick, alloyed with silver is built up in a selenium diode in the 20 rectifying contact region between a layer of selenium and a layer of cadmium selenide, or a layer of another semiconductor or metal producing in conjunction with selenium a rectifying contact. The concentration of 25 silver may vary from several fractions of a per cent to several per cent. The layer of selenium alloyed with silver may be replaced by a layer of silver selenide of a thickness from 1 to 2 microns. Alternatively the layer 30 of pure selenium and the layer of selenium alloyed with silver, or the layer of silver selenide, may be replaced with a single layer of silver selenide 5 to 10 microns thick and the cell electroformed by reverse current.

35 A suitable substrate for the cell may be a semi-conductor, with an optimum coefficient of linear thermal expansion  $\alpha$  of  $22.10^{-6}$  deg. C.  $^{-1}$ . Whenever the  $\alpha$  of the substrate materially differs from the  $\alpha$  of selenium, for instance, when the cell is prepared on the surface of a germanium or

[Price 4s. 6d.]

silicon monocrystal, it is advisable to affix the selenium layer by building up a sub-layer displaying a good cohesion with the substrate surface and a satisfactory cohesion with the lower ohmic contact of the cell, for instance a thin layer of bismuth. A variant of cell preparation is described below. In this example the  $\alpha$  of the substrate disagrees with the  $\alpha$  of selenium the substrate comprising, for instance, a germanium or silicon monocrystal.

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A layer of aluminium up to 1 micron thick may be sprayed in high vacuum on the monocrystal surface with the aid of a stencil having the configuration of the cell and a current lead. The last decimal fractions of aluminium are sprayed in conjunction with the bismuth. The temperature of the substrate (monocrystal surface) ranging from 120 to 150°C., the surface of the layer thus obtained should have a slightly dull look.

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After the bismuth has been sprayed the vacuum conditions are not disturbed and a layer of pure (unalloyed) selenium is sprayed to a thickness of 5 to 7 microns, the crystal temperature being maintained at about 50°C. The layer is crystallised in atmospheric conditions at 200°C for one hour. The hexagonal selenium layer prepared as above has a texture with the axis C oriented along the monocrystal surface.

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Under such conditions the surface of the selenium layer is covered with a layer of selenium mixed with silver built up by spraying to a thickness of 2—3 microns. The higher the silver concentration, the larger the commutation time  $I$  of the cell and more stable the states 1 and 0 are. Depending on silver concentration, the time  $I$  varies from several microseconds to a few milliseconds, and the information can be read off several

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dozen times to  $10^7$  to  $10^8$  and even more times.

5 An upper rectifying contact can be made of cadmium alloyed with tin; this cadmium layer being 0.5—1.0 microns thick covered with a thick layer of tin of 1 to 3 microns. The upper cell electrode is connected with the respective elements of the film or solid circuit by leads provided by pulverisation 10 through stencils.

10 Other methods of preparing the cell can be used. For instance the layer of selenium alloyed with silver can be substituted by a layer of silver selenide interposed between the layer of pure selenium and the upper electrode; or the layer of pure and alloyed selenium may be replaced by a single layer of silver selenide.

15 In such cases the cell is required to be 20 electroformed in blocking direction for a lengthy period of time in order to obtain a layer of selenium with silver admixture in the rectifying contact region at the expense of silver selenide.

25 WHAT WE CLAIM IS:—

1. A method of preparing a memory cell

in which a thin layer of selenium, 2 to 3 microns thick, alloyed with silver is built up in a selenium diode in the rectifying contact region between a layer of selenium and a layer of another semiconductor or metal 30 producing in conjunction with selenium a rectifying contact.

2. A method according to claim 1 wherein the layer of selenium alloyed with silver is 35 replaced by a layer of silver selenide of a thickness from 1 to 2 microns.

3. A method according to claim 1 or 2 wherein the layer of non-alloyed selenium, and the layer of selenium alloyed with silver or the layer of silver selenide, are replaced 40 with a single layer of silver selenide 5 to 10 microns thick and the cell is electroformed by reverse current.

4. A method of preparing a memory cell 45 substantially as herein described.

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